THE USE OF CNIDOCYSTS FOR ECOLOGICAL RACES IDENTIFICATION FROM SEA ANEMONES POPULATIONS (ANTHOZOA, ACTINIIDAE)

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ABSTRACT

The cnidocysts spirocysts, microbasic b-mastigophore, microbasic p-mastigophore and atrichs from tentacles, column and acrorhagi of *Phymactis clematis* Dana, 1849, *Aulactinia marplatensis* (Zamponi, 1977), *A. reynaudi* (M.-Edwards, 1857) and *Oulactis muscosa* Dana, 1849 (Actiniidae) from three intertidal zones of Argentine shore are studied. Treatment of data were made on 5400 cnidocysts by mean an discriminant analysis (BMDP computer programs). Three groups (ecological races) for each species according to the zone were identified, and the results were statistically significant. The microbasic b-mastigophore has the highest variability within them, being the more important type to recognition ecological races.

KEYWORDS. Actiniaria, cnidocysts, variation, intertidal, Argentine shore.

INTRODUCTION

The variation in size of cnidocysts has been used as a tool in the description of species (CARLGREN, 1940, 1945; HAND, 1961). WEILL (1934) considered that the influence of exogenous and endogenous factors can affect the distribution and size of cnidocysts. ZAMPONI & A.-TELLECHEA (1988) demonstrated that some nematocysts (desmoneme, stenotele and heterotrichous anisorhiza) have a paralyzing function and consequently are larger. FAUTIN (1988) suggested a specific alternative study of the origin of the samples to determine if such variability is caused by external factors. ZAMPONI & ACUÑA (1991) observed for *Actinostola cassicornis* Hertwig, 1882, *Carcinactis dolosa* Riemann-Zürneck, 1975, *Actinauge longicornis* Verrill, 1882, *Bolocera kerguelensis* Studer, 1979, and *Choriactis laevis* Carlgren, 1899, clinal variation in cnidocysts size.

The variation allied with other morphological and ecological characteristics would

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permit the recognition of several actiniarian populations. For this reason we provide a comparative study of the cnidocyst size of four Actiniidae species.

MATERIALS AND METHODS

The specimens of *Phymactis clematis* Dana, 1849, *Aulactinia marplatensis* (Zamponi, 1977), *A. reynaudi* (M.-Edwards, 1857) and *Oulactis muscosa* Dana, 1849 were taken from July 1990 to July 1992 in the intertidal areas of the beaches Punta Cantera and Punta Piedras in Mar del Plata (38°05'S, 57°32'W) and from Santa Clara del Mar (37°50'S, 57°30'W), Argentina. Punta Cantera and Punta Piedras have a quartzitic substrate where there are exposed and protected areas inhabiting by several benthic organisms such as sponges, cnidarians, molluscs, nemerteans, polychaetes and crustaceans. In Santa Clara del Mar the beach consists of a 5 m high embankment and a gently shelving floor with drainage channels running perpendicular to the coast, and has an intertidal endolithic fauna associated to a compact sedimentary rocks, sometimes cemented by cristalline calcium carbonate, and is of variable colour and hardness. In the three locations the sea rises 50 cm up, the embankment at normal high tide, but under southeast storm conditions can completely cover it.

One hundred cnidocysts of each kind (total= 5400) were measured using the methodology of ZAMPONI & ACUÑA (1994). The cnidocysts were prepared according to HAND's (1954) technique and classified according to ENGLAND (1991). The abbreviations of cnidocysts were (1) tentacle: bmt, microbasic b-mastigophore; et, spirocyst; (2) column: ac, atrichs; bmc, microbasic b-mastigophore; pmc, microbasic p-mastigophore; acrorhagi: aa, atrichs; bma, microbasic b-mastigophore.

A discriminant statistical analysis for each species was done taking into consideration the three areas of the study and the variables were the different cnidocysts. Program 7M of the BMDP package of programs was used. The significance level used was 0.05.

RESULTS

Phymactis clematis. The coefficients of correlation between cnidocysts were: et-bmt -0.00501; et-pmc 0.04590; et-bmc -0.03882; bmt-pmc -0.06565; bmt-bmc -0.00879; pmc-bmc 0.01514.

Were observed statistically significant differences (table I) between individuals of Punta Cantera and Punta Piedras (F= 155.04); Punta Cantera and Santa Clara del Mar (F= 149.96); but not between Punta Piedras and Santa Clara del Mar (F= 4.69), thus, both could be considered as only one group. Individuals from each area represented according to the canonical variables obtained by the discriminant analysis (fig. 1).

According to the value of F for each one of the cnidocysts, the one that best differentiates the group is microbasic b-mastigophore of tentacle (F=156.76) followed in descending order by microbasic p-mastigophore of the column (F=127.72), microbasic b-mastigophore of column (F=95.08) and spirocyst of tentacle (F=20.72).

The following are the discriminant functions for each group which allow a new member to be classed in a group according to the value of its variables, in this case, the size of cnidocysts: $L(X)pc= 0.3273X1 + 4.4000X2 + 2.9009X3 + 2.9896X4 - 86.6000$, $L(X)pp= 0.4522X1 + 5.7047X2 + 3.6676X3 + 3.7500X4 - 139.0103$, $L(X)sc= 0.4171X2 + 5.4951X2 + 3.7731X3 + 3.8604X4 - 137.7480$; where $X1=$ et, $X2=$ bmt, $X3=$ pmc, $X4=$ bmc.

Aulactinia marplatensis. The coefficients of correlation between cnidocysts were: et-bmt 0.02339; et-pmc 0.02276; et-ac 0.06308; bmt-pmc 0.08881; bmt-ac 0.02106; pmc-ac: 0.06828.

Were observed statistically significant differences between individuals of all zones: Punta Cantera and Punta Piedras (F= 183.13); Punta Cantera and Santa Clara del Mar (F= 211.67); Punta Piedras and Santa Clara del Mar (F= 65.60) (table II). Individuals from each area according to the canonical variables obtained from the discriminant analysis (fig. 2).

The cnidocyst that defines the group better is microbasic b-mastigophore of the

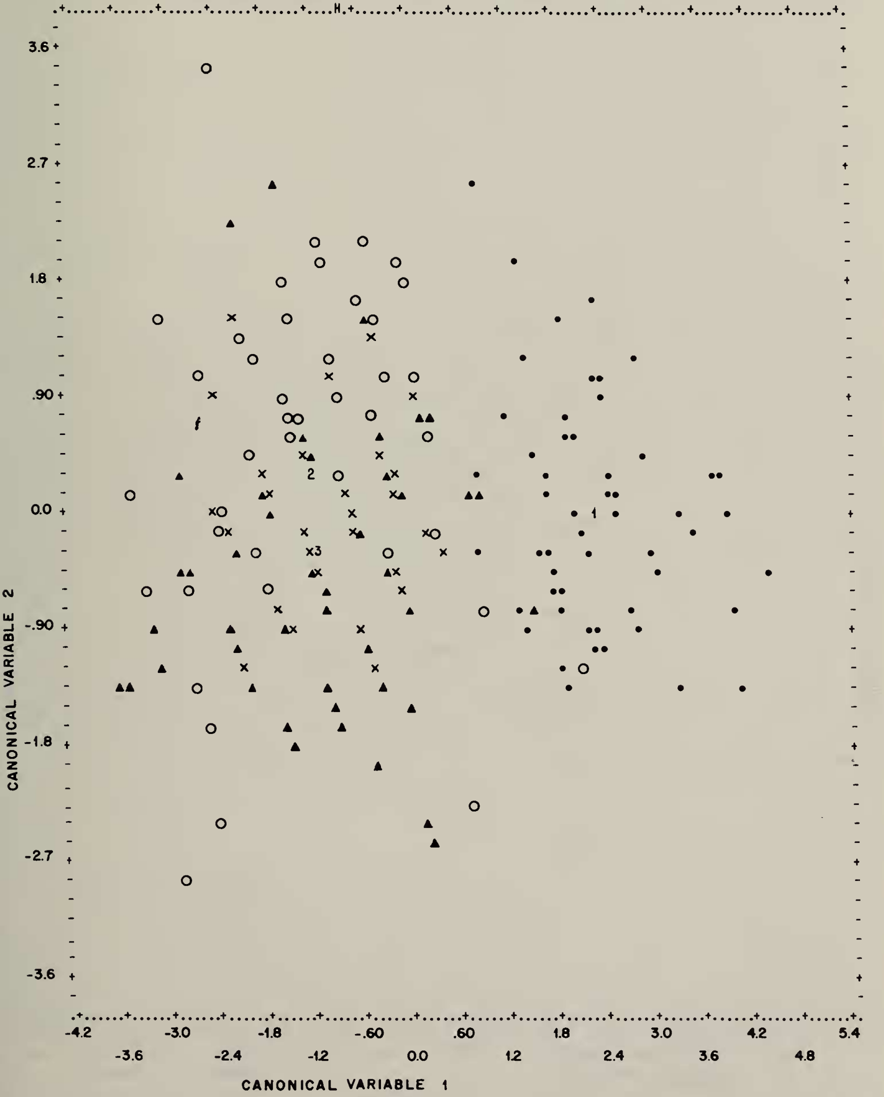

Fig. 1. Individuals of *Phymactis clematis* in the different zones according with cnidocysts size. (●,Punta Cantera; o Punta Piedras; ▲,Santa Clara del Mar; 1, 2, 3, groups centers; X, superpossed individuals).

tentacle (F=216.22) followed by microbasic b-mastigophore of the column (F=164.82), atrichs of the column (F=151.50) and spirocyst of the tentacle (F=147.01).

The discriminant functions for each group are the following: L(X)pc= 3.7097X1 + 4.5110X2 + 3.5791X3 + 1.1352X4 - 112.2118, L(X)pp= 4.7533X1 + 5.8880X2 + 2.5036X3 + 1.0368X4 - 170.2202, L(X)sc= 4.6145X1 + 5.6286X2 + 4.7188X3 + 1.5080X4 - 181.9610; where X1= et, X2= bmt, X3= bmc, X4= ac.

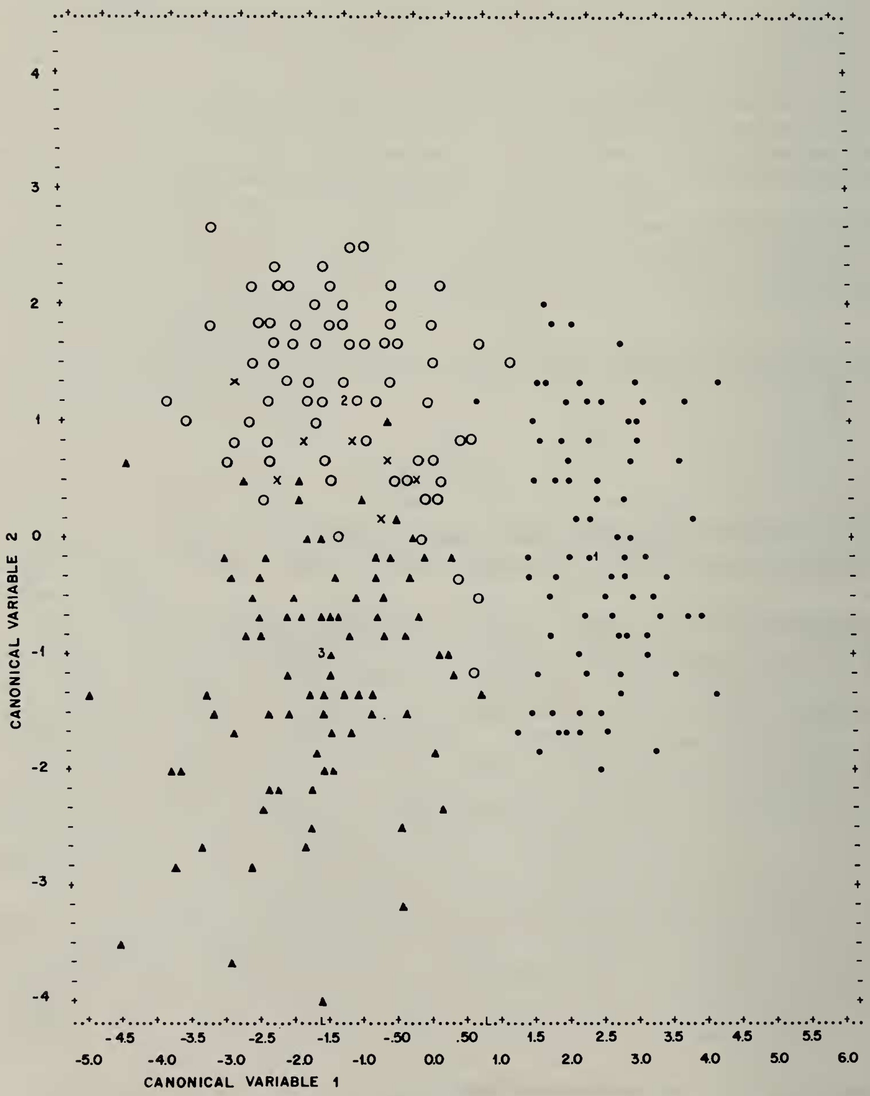

Fig.2. Individuals of *Aulactinia marplatensis* in the different zones according with cnidocysts size. (●, Punta Cantera; o Punta Piedras; ▲,Santa Clara del Mar; 1, 2, 3, groups centers; X, superpossed individuals).

Aulactinia reynaudi. The coefficients of correlation between cnidocyst were: et-bmt 0.08313; et-bmc 0.12476; et-ac -0.04053; bmt-bmc 0.03435; bmt-ac 0.07077; bmc-ac -0.16035. Individuals from the three areas under study have statistical differences: Punta Cantera and Punta Piedras (F= 80.06); Punta Cantera and Santa Clara del Mar (F= 176.71); Punta Piedras and Santa Clara del Mar (F= 50.31) (table III). Individuals according to the canonical variables obtained from the discriminant analysis (fig. 3).

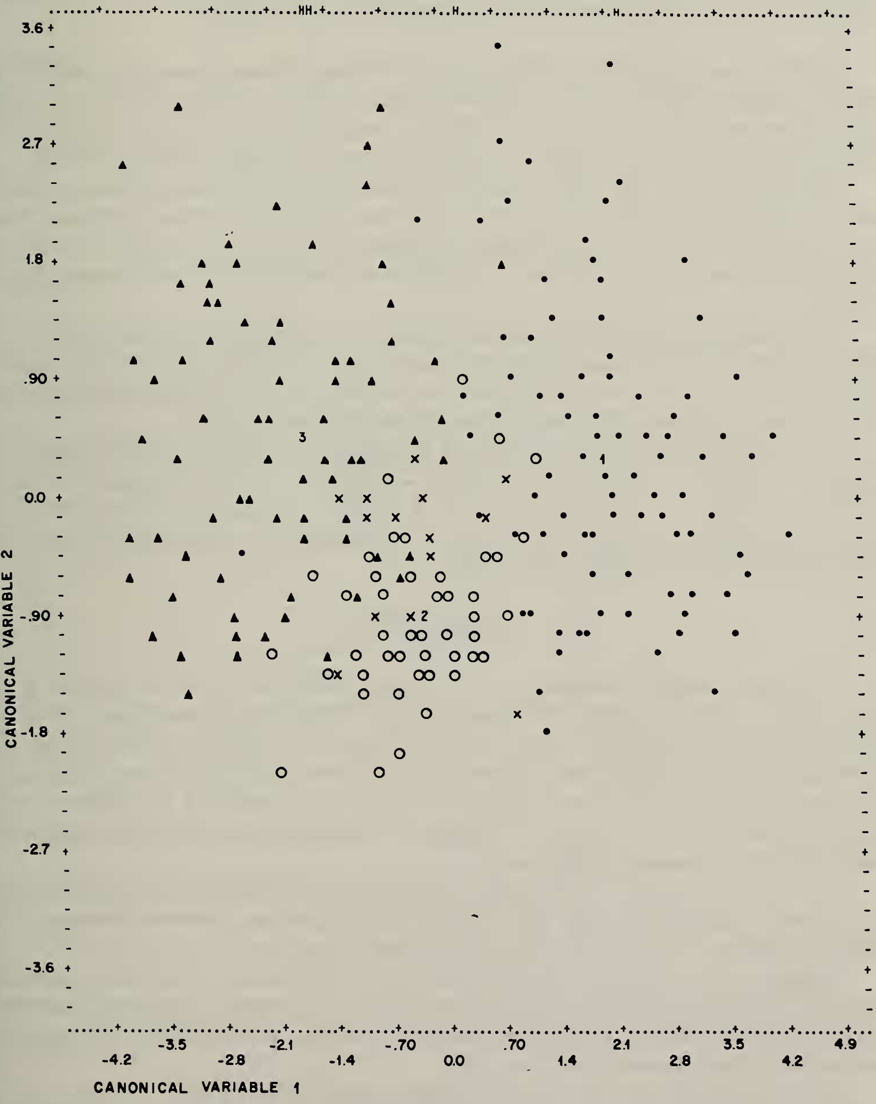

Fig. 3. Individuals of *Aulactinia reynaudi* in the different zones according with cnidocysts size. (●, Punta Cantera; o Punta Piedras; ▲,Santa Clara del Mar; 1, 2, 3, groups centers; X, superpossed individuals).

The cnidocyst that best defines the group is microbasic b-mastigophore of tentacle (F=205.50), then spirocyst of the tentacle (F=105.46), microbasic b-mastigophore of the column (F=81.03) and atrichs of the column (F=62.01).

The discriminant functions for each group are the following: L(X)pc= 2.2187X1 + 4.3263X2 + 2.7964X3 + 1.3277X4 - 96.2795, L(X)pp= 2.7409X1 + 5.2605X2 + 3.1514X3 + 1.2142X4 - 125.9636, L(X)sc= 2.8541X1 + 5.7011X2 + 3.5226X3 + 1.5474X4 - 154.4712; where X1= et, X2= bmt, X3= bmc, X4= ac.

Oulactis muscosa. The coefficients of correlation between cnidocysts were: et-bmt -0.04975; et-bmc 0.03149; et-ac -0.00740; et-aa -0.02821; et-bma 0.03481; bmt-bmc 0.02113; bmt-ac 0.06273; bmt-aa -0.17257; bmt-bma 0.01382; bmc-ac -0.12021; bmc-aa 0.01957; bmc-bma -0.07735; ac-aa -0.05927; ac-bma -0.04608; aa-bma 0.05229.

Individuals from the three zones were statistically differents according with the studied variables: Punta Cantera and Punta Piedras: (F= 80.21), Punta Cantera and Santa Clara del Mar (F= 83.57),Punta Piedras and Santa Clara del Mar (F= 121.68) (table IV). Individuals according to the canonical variables obtained from the discriminant analysis (fig. 4).

The cnidocyst that best defines the group is the atrichs of acrorhagi (F=273.73), followed by microbasic b-mastigophore of acrorhagi (F=141.53), atrichs of the column (F=95.55), microbasic b-mastigophore of the tentacle (F=39.67), spirocyst of tentacle (F=29.43) and microbasic b-mastigophore of the column (F=1.51).

The discriminant functions for each group are as follows: L(X)pc= 4.609X1 + 6.448X2 + 4.984X3 + 3.506X4 + 3.311X5 + 4.071X6 - 315.885, L(X)pp= 5.023X1 + 7.144X2 + 5.195X3 + 3.998X4 + 3.567X5 + 5.166X6 - 388.153, L(X)sc= 5.063X1 + 6.587X2 + 5.226X3 + 4.232X4 + 2.814X5 + 4.340X6 - 329.300; where X1= et, X2= bmt, X3= bmc, X4= ac, X5= aa, X6= bma.

DISCUSSION

From the analysis on cnidocysts of *P. clematis* and taking into account the size of these cellular structures, we deduce that this species presents at least three statistically different groups (ecological races), one in each area of study (the three areas were statistically discriminated). However, the separation among individuals from Punta Piedras and Santa Clara del Mar is not significant. Cnidocysts studied of *P. clematis* had no correlation among themselves and microbasic b-mastigophore of tentacle was the one which best discriminated the three areas.

In *A. marplatensis* as in *P. clematis* it was possible to identify individuals according to the size of cnidocysts in the three areas. The differences observed between Punta Cantera and Santa Clara del Mar were particularly important.

Equally, *A. reynaudi* is discriminated in the three areas of the study, especially between individuals from Punta Cantera and Santa Clara del Mar. The cnidocysts of this species had no correlation among themselves. Microbasic b-mastigophore of tentacle is the one which best discriminates the group.

In *O. muscosa*, also, the perfect discrimination of the groups was observed. The cnidocysts do not have any correlation among themselves. Atrichs of acrorhagi was the best to discriminate the groups.

The differences observed between size cnidocysts of different species are not a consequence of a clinal variation. Clinal variations have been observed in actiniarians by ZAMPONI & ACUÑA (1991) but these variations are gradual and occur in very large areas as stated by LAURENT (1972). This was not observed in the studied areas. It is possible that the variation in these cellular structures occurs due to the different conditions, such as olaje and substrate, that prevail in each area. This confirmed the

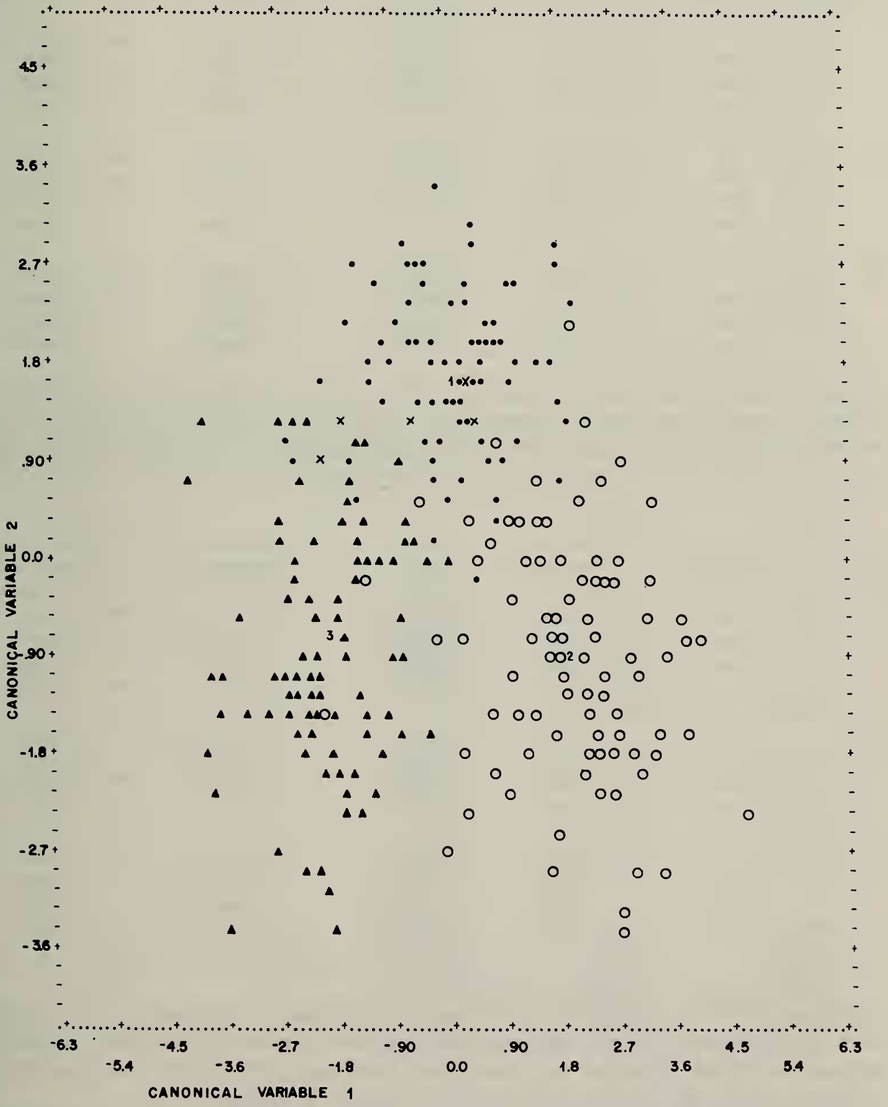

Fig. 4. Individuals of *Oulactis muscosa* in the different zones according with cnidocysts size. (●, Punta Cantera; o Punta Piedras; ▲,Santa Clara del Mar; 1, 2, 3, groups centers; X, superpossed individuals).

Table I. Statistical data of the variables (cnidocyst) of *P. clematis* in the studied zones. PC, Punta Cantera; PP, Punta Piedras; SC, Santa Clara del Mar. (et, spirocyst of tentacle; bmt, microbasic b-mastigophore of tentacle; pmc, microbasic p-mastigophore of column; bmc=microbasic b-mastigophore of column).

Zone	Cnidocyst	Number	Mean	Standard deviation	Coefficient of variation
PC	et	100	16.04800	11.45331	0.71369
	bmt	100	17.56800	1.70151	0.09685
	pmc	100	16.84800	1.53323	0.09685
	bmc	100	12.76800	1.40151	0.10977
PP	et	100	22.15300	2.66506	0.12030
	bmt	100	22.37900	2.28581	0.10214
	pmc	100	21.31500	3.14750	0.14767
	bmc	100	15.99100	2.33546	0.14605
SC	et	100	20.49900	2.46140	0.12007
	bmt	100	21.46900	2.09288	0.09748
	pmc	100	22.01500	2.48943	0.11308
	bmc	100	16.50300	2.34901	0.14234

Table II. Statistical data of the variables (cnidocyst) of *A.marplatensis* in the studied zones. PC, Punta Cantera; PP, Punta Piedras; SC, Santa Clara del Mar. (et, spirocyst of tentacle; bmt, microbasic b-mastigophore of tentacle; bmc, microbasic b-mastigophore of column; ac, atrichs of column).

Zone	Cnidocyst	Number	Mean	Standard deviation	Coefficient of variation
PC	et	100	16.36800	1.57319	0.09611
	bmt	100	16.88000	1.56528	0.09273
	bmc	100	14.32000	1.14557	0.08000
	ac	100	30.04600	5.02920	0.16738
PP	et	100	20.72700	2.22229	0.10722
	bmt	100	21.89400	1.86156	0.08503
	bmc	100	17.86000	2.13054	0.11929
	ac	100	29.29700	2.72639	0.09306
SC	et	100	20.44100	2.17237	0.10628
	bmt	100	21.15300	2.06091	0.09743
	bmc	100	18.76800	2.04993	0.10922
	ac	100	39.64000	5.75707	0.14523

variations observed by PÉREZ (1992) in the epithelial microanatomy of *P. clematis* from the same areas study. Moreover, this author observed statistically significant differences in the variation of some structures (vesicles, tentacles, mesenteries) of taxonomic value for *P. clematis*, *A. marplatensis* and *A. reynaudi*.

The term race does not imply a special taxonomic meaning, but it can be considered as a group of common terms of specific subgroups, such as "variety", "form" and "stock"

Table III. Statistical data of the variables (cnidocyst) of *A. reynaudi* in the studied zones. PC, Punta Cantera; PP, Punta Piedras; SC, Santa Clara del Mar. (et, spirocyst of tentacle; bmt, microbasic b-mastigophore of tentacle; bmc, microbasic b-mastigophore of column; ac, atrichs of column).

Zone	Cnidocyst	Number	Mean	Standard deviation	Coefficient of variation
PC	et	100	16.43200	2.44779	0.14897
	bmt	100	17.15200	1.60935	0.09383
	bmc	100	14.57600	3.41799	0.23449
	ac	100	29.32800	5.96092	0.20325
PP	et	100	20.26500	1.99597	0.09849
	bmt	100	20.57300	1.64125	0.07978
	bmc	100	17.17000	1.23603	0.07199
	ac	100	26.23300	2.39431	0.09127
SC	et	100	21.21600	2.87573	0.13555
	bmt	100	22.42000	2.26845	0.10118
	bmc	100	18.66900	1.63285	0.08746
	ac	100	33.99800	5.71457	0.16809

Table IV. Statistical data of the variables (cnidocyst) of *O. muscosa* in the studied zones. PC, Punta Cantera; PP, Punta Piedras; SC, Santa Clara del Mar; (et, spirocyst of tentacle; mbt, microbasic b-mastigophore of tentacle; mbc, microbasic b-mastigophore of column; ac, atrichs of column; aa, atrichs of acrorhagi; mba, microbasic b-mastigophore of acrorhagi).

Zone	Cnidocyst	Number	Mean	Standard deviation	Coefficient of variation
PC	et	100	18.87700	1.99311	0.10558
	mbt	100	20.92100	1.78842	0.08548
	mbc	100	19.58800	1.50207	0.07668
	ac	100	19.34500	1.42058	0.07343
	aa	100	52.97200	4.39290	0.08293
	mba	100	16.39900	1.35023	0.08234
PP	et	100	20.63400	1.88911	0.09155
	mbt	100	23.38800	2.22517	0.09514
	mbc	100	19.99300	2.41202	0.12064
	ac	100	22.26200	1.91051	0.08582
	aa	100	56.93700	4.74615	0.08336
	mba	100	20.91700	2.80321	0.13466
SC	et	100	20.98000	2.32800	0.11096
	mbt	100	22.37600	1.86554	0.08337
	mbc	100	20.05800	2.19348	0.10936
	ac	100	24.43200	3.84584	0.15741
	aa	100	42.80400	3.94710	0.09221
	mba	100	17.06900	1.52830	0.08954

(WILLIAMS, 1973). It is possible that the ecological races are closely related with physiological races as pointed out by WILLIAMS (1973) for the sea anemone *Haliplanella luciae* Hand, 1955. UCHIDA (1936) described four races in *H. luciae* in

Japan, based on color differences and suggesting that their distribution is influenced by the effect of temperature and ocean currents.

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